ALPHA-GAMMA
TECHNOLOGIES, INC.

MEMORANDUM

DATE: June 18, 2002

SUBJECT: Performance / Test Data for Large Municipal Waste Combustors (MWCs) at MACT Compliance (Year 2000 data)

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This memorandum summarizes the performance of maximum achievable control technology (MACT) at large municipal waste combustor (MWC) units. The retrofit of MACT was required by emission guidelines established under Section 129 of the Clean Air Act. The guidelines for large MWCs were adopted in 1995 under 40 CFR part 60, subpart Cb, and required emission control retrofit by December 2000. This memorandum is a companion to two other memoranda. First, it is a companion to the memorandum "Emissions from Large Municipal Waste Combustion Units (MWCs) Following MACT Retrofit (year 2000 test data)" Docket A-90-45; Item VIII-B-3. That memorandum presents annual emissions from large MWC units and is based on the stack test data discussed in this memorandum. Second, it is a companion to the memorandum " Lee County MWC Emissions Variability Analysis" Docket A-90-45 ; Item VIII-B-10. That memorandum reviews the year-to-year emissions variability that occurs at an MWC. The Lee County MWC was equipped with MACT at start up in 1994 and test data was obtained for all years since start-up. The Lee County analysis is useful when reviewing the variation in MACT retrofit performance observed at the 167 large MWCs.

Following MACT retrofit in December 2000, the U.S. Environmental Protection Agency (U.S. EPA) obtained stack test reports from all 167 large MWC units. The data in the stack test reports have been compiled and presented in tables, plots and statistical figures in this memorandum. The data are arranged as:

(1) Frequency distributions of test data
(2) Data plots and statistics
(3) Emission factors
(4) Parameter ratios
(5) MWC Inventory and date of stack test
(6) Subpart Cb Emission Guidelines - Summary

At the end of this memorandum, Tables 1, 2, 3 and 4 present general summaries of the test data and analysis. More detailed information can be found in Attachments 1 through 6.

Attachment 1– Frequency distributions of test data

Attachment 1 presents MACT performance data for all Section 129 pollutants including; dioxin/furans (CDD/CDF), mercury (Hg), cadmium (Cd), lead (Pb), particulate matter (PM), hydrochloric acid (HCl), sulfur dioxide (SO_2), and nitrous oxides (NO_x). Two formats of data are presented for CDD/CDF and SO_2. For CDD/CDF, data are presented in both a total mass basis and toxic equivalent quantity (TEQ) basis. The total mass basis can be used to compare MACT performance with the subpart Cb emission guidelines and the TEQ basis data can be used for both TEQ emissions calculations and for comparison with permits drafted in a TEQ format. For SO_2, data are presented in both an arithmetic average basis and a geometric mean basis. The geometric mean basis can be used to compare performance with the subpart Cb emission guidelines, and the arithmetic average basis used for both calculating annual emissions and for developing emission factors. In presenting the performance of the MACT retrofits, a frequency analysis was performed using the histogram utility of EXCEL. The stack test results from the 167 MWC units were categorized under 13 bin ranges. Depending on the maximum and

minimum values, the limits on the bins are varied. Table 1 presents the mean (average) performance of the 167 MACT retrofits. The performance of MACT retrofits has been outstanding.

Attachment 2 – Data plots and statistics

Attachment 2 presents various data plots and statistics on MACT performance. The information is subdivided by MWC type and air pollution control device (APCD) combination. Appendix 2 also presents information on the APCD used for MACT retrofit. The most common configuration was spray dryer/fabric filter (SD/FF) and it was used at 138 of the 167 MWCs. Table 2 presents a summary of APCD used.

Attachment 3 – Emission factors

This attachment presents emission factors for various MWC /APCD combinations. The emission factors were calculated using the stack test data. First, the stack test data was used to calculate annual emissions, then this was divided by the amount of municipal solid waste (MSW) fired during the year. The emission factors are presented in dimensional units of emissions (kg) per unit of waste fired (Mg). Table 3 presents a summary of emission factors developed.. In most cases these emission factors are similar to current AP-42 emission factors but some (e.g. mercury) are noticeably different (lower).

Attachment 4 – Parameter ratios

This attachment presents pollutant and process ratios calculated from the collected MWC unit data. The calculated ratios are;

- CDD/CDF total mass basis versus TEQ basis
- SO_2 geometric mean versus SO_2 arithmetic average
- Flue gas flow rate versus municipal waste fired

- Annual municipal waste combusted versus unit capacity
- Steam generation versus municipal waste combusted

Linear regression analysis was carried out by the least squares method and a straight line was fitted onto the data by EXCEL's regression utility. The slope of the line represents the ratio for the aforementioned relationships. Table 4 presents the various ratios calculated from the data. As show in the table, the CDD/CDF total mass / TEQ ratio was 51.1 : 1 and the annual capacity factor was 85 percent.

Attachment 5 – MWC Inventory and date of stack test

This attachment lists the 167 MWC units in the large MWC category. It includes data on MWC location, type, size, and APCD used. It also lists the date of the stack test used in this analysis.

Attachment 6 – Subpart Cb Emission Guidelines - Summary

Attachment 6 presents a summary of the 40 CFR Part 60, Subpart Cb emission guidelines. When these guidelines were adopted in 1995 they applied to both large and small MWC units, but were amended in 1997 to apply only to MWC units with individual unit combustion capacity greater than 250 tons per day (large MWC units). The final guidelines applied to 167 large MWC units.

Table 1. Average Performance of MACT Retrofits at 167 Large MWC units

(see Attachments 1 and 2)

Section 129 Pollutants	Dimensional Unit [1]	Average Performance After MACT Retrofit [2]
Dioxin/Furan, Total Mass Basis	ng/dscm	4.5
Dioxin/Furan, TEQ Basis [3]	ng/dscm	0.079
Mercury	mg/dscm	0.014
Mercury Reduction	percent	92
Cadmium	mg/dscm	0.0022
Lead	mg/dscm	0.029
Particulate Matter	mg/dscm	4.7
HCl	ppmV	11
HCl Reduction	percent	98
SO_2 Arithmetic Average	ppmV	10
SO_2 Geometric Average	ppmV	8.8
SO_2 Reduction	percent	90.0
NO_X	ppmV	170

[1] All pollutant concentrations are corrected to 7% O_2.
[2] Average of MACT performance level of all 167 large MWC units.
[3] 1989 NATO toxicity factors

Table 2. Air Pollution Control Device (APCD) Used for MACT Retrofit

(see Attachment 2)

Air Pollution Control Device (APCD) Used	Number of MWC Units
Spray Dryer / Fabric Filter	138
Spray Dryer / Electrostatic Precipitator	25
Carbon Injection	120
SNCR	130

Table 3. Emission Factors of Large MWC units after MACT Retrofits

(see Attachment 3)

Section 129 Pollutants	Emission Factors [1] (kg pollutant per Mg waste fired)
Dioxin/Furan, total mass basis	2.67×10^{-8}
Dioxin/Furan, TEQ basis	4.72×10^{-10}
Mercury	7.86×10^{-5}
Cadmium	1.19×10^{-5}
Lead	1.70×10^{-4}
Particulate Matter	2.53×10^{-2}
HCl	9.55×10^{-2}
SO_2	1.46×10^{-1}
NO_x	2.00

[1] The emissions factors were developed by totaling the emissions of all167 MWC units and dividing by the total waste combusted. (see Docket A-90-45; Item VIII-B-3).

Table 4. MWC Parameter Ratios and Regression Statistics

(see Attachment 4)

Parameter	Dimensional Units	Ratio	Number of Points	R Squared
CDD/CDF Total Mass / TEQ Ratio	dimensionless	51:1	124	0.953
SO_2 Arithmetic/Geometric Average	dimensionless	1.1:1	79	0.928
Stack Flow Rate / Waste Fired	dscm/ton waste	4,560:1	167	0.673
MWC Capacity Factor	percent	85	167	0.847
Steam Generation / Waste Fired	lb steam/ton waste	6,386:1	167	0.938